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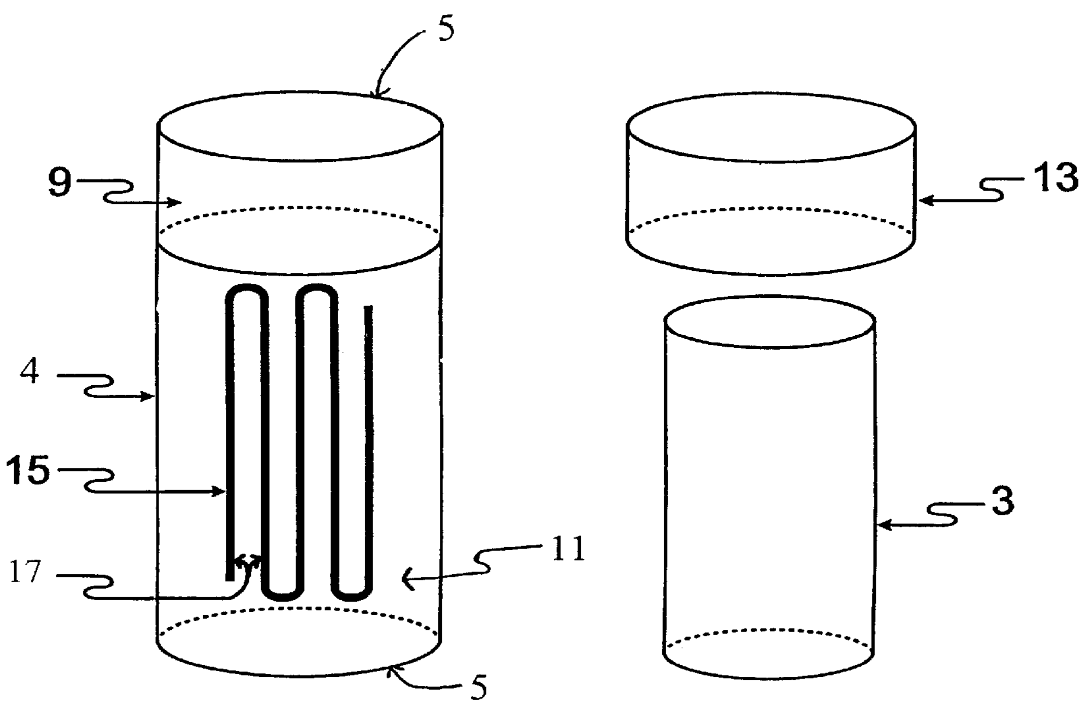
(54) Title: HERMETICALLY SEALED BAITS FOR TERMITES



(57) Abstract: Disclosed is a hermetically sealed (4) termite bait (3) station having an electrical bridging circuit (15) useful in the elimination of termite colonies and a method of substantially eradicating termites in an area comprising placing in the area at least one such hermetically sealed station.

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HERMETICALLY SEALED BAITS FOR TERMITES

BACKGROUND OF THE INVENTION

Field of the Invention

This invention relates to a hermetically sealed termite bait station having an electrical bridging circuit useful in the elimination of termite colonies. This invention further relates to a method of substantially eradicating termites in an area comprising placing in the area at least one hermetically sealed station of the type referred to above.

Description of the Related Art

Over the last four decades, control of subterranean termites have heavily relied on the use of liquid insecticides. Typically 100-200 gallons (or 5-10 kg active ingredient) of insecticide are applied to soil surrounding or beneath a house to exclude soil borne termites from structures. Because a subterranean termite colony can contain several hundred thousand to millions of termites that forage up to 300 feet from the nest, the majority of termites in a colony usually survive such soil treatments. In recent years, with less persistent insecticides being used as chemical barriers, re-infestation by surviving termites has become more frequent.

One alternative to conventional soil treatment is the use of slow-acting bait to control populations of subterranean termites. The monitoring/baiting program incorporating an insect growth regulator, hexaflumuron, as described by Su, N.-Y., Field Evaluation of a Hexaflumuron Bait for Population Suppression of Subterranean Termites (Isoptera: Rhinotermitidae), *Journal of Economic Entomology* **87**: 389-397 (1994) is now commercially marketed as the Sentricon® Termite Colony Elimination System. Unlike conventional soil insecticide treatment, the monitoring/baiting program relies on routine

monitoring to protect a given area. When termites are found in the monitoring stations, the monitoring devices are replaced with baits containing hexaflumuron. Baits containing the active ingredient are not used until termites are detected. This arrangement drastically reduces pesticide use for control of subterranean termites.

A key component of the Sentricon system is the monitoring step. An example is found in EP 0 283 142 A1, which teaches a monitoring apparatus that includes a plurality of detectors distributed over an area, each detector linked to an indicator that sends signals to the detectors and each detector responds only if it has detected a pest. Responders then permit the indicators to check on whether or not the links between the indicator and the detectors are intact. This system is not, however, specific to termites, and false positive results can occur.

There are other techniques available to detect the presence of termites in wood or soil. For example, Japanese Pat. No. 9-121742 (Sharp K.K., 5/1997) discloses an apparatus in which an optical sensor is employed to detect termite movement in a pre-drilled foraging tunnel in a wood block. However, the presence of subterranean termites is usually associated with elevated moisture (Su & Scheffrahn 1991, IRG/WP/1504). U.S. Pat. Nos. 4,812,741 (Stowell *et al.*, March 14, 1989) and 5,126,679 (Spry, June 30, 1992) teach the use of a moisture sensor to signal the presence of termites. Further, termites are known to produce gases such as CO_2 and methane. Such gases can be detected in the ground by use of subterranean probes (U.S. Pat. No. 3,943,750; McLaughlin *et al.*, March 16, 1976). Unfortunately, many other factors can produce moisture or subterranean gases such as leaky plumbing, rainfall, putrefaction or fungal decay. Because these conditions are not unique to termite activity, monitoring stations adapted with these sensors or probes can cause false alarms and account for frequent,

costly, and unnecessary on-site inspections.

Other methods and devices for detecting infestation of termites have emerged. For instance, U.S. Pat. No. 5,592,774 (Galyon, January 14, 1997) discloses a two-sensor system in which both sensors detect termite-presence conditions such as high humidity and gases. It is expected that when termites invade only one sensor, its condition (high moisture, gases, etc.) would be significantly different from the other, thus signaling the presence of termites. There is no guarantee, however, that only one sensor is invaded by termites, especially in areas of high termite population. Therefore, this arrangement does not address the problem of both sensors being simultaneously invaded by termites, thereby signaling a false negative response. In addition, microenvironment differences (slight humidity difference due to water flow in soil, etc.) can signal a false positive response with this type of system. Moreover, the presence of other soil dwelling insects such as earthworms, ants, and beetle larvae also produce termite-presence conditions such as high humidity and gases. Again, because such conditions are not unique to termite activity, invasion by these soil dwelling insects will cause false positives and costly, unnecessary on-site inspections.

U.S. Patent No. 5,575,105 discloses a cellulose-based member with a plurality of holes transversely extending through it, each hole provided with an infrared emitting element that detects the presence of termites by an obstruction of an output wave caused by termites invading the holes. A detection signal is then generated to cause alarm lights to light up. The approximate number of termites can also be determined by counting the occurrences of the obstruction of output waves. The invasion of the holes by other insects and the presence of certain environmental conditions again renders this method susceptible to false positive responses.

Another method of termite monitoring focuses on detecting termite feeding by vibrations or sound transmitted through wood when termites tear and break wood fibers (U.S. Pat. No. 4,941,356, Pallaske 7/1990; Japanese Pat. H-7142827, Ikari 6/1995; PCT Publication No. WO93/23998). Such acoustic signals, however, can also be generated by other wood destroying insects such as powder beetles, bark beetles, house boarder, and carpenter ants, which also break wood fibers and thus can cause false positive responses. Moreover, these methods and apparatuses typically employ elaborate sensors that detect a narrow range of sound or vibration frequency, costly amplifiers to enhance the signals, and complex computer chips to interpret the signals.

These acoustic emission devices can be useful as hand-held tools to detect activities of termites and other wood destroying insects in structures (Scheffrahn *et al.* 1997, *J. Econ. Entomol.* **90**: 492-502). Because 30-40 monitoring stations are needed to protect a house for a monitoring/baiting program, however, it is cost-inhibitory to utilize such acoustic emission devices (generally > $1,000 per unit) in all of the stations. It is therefore highly desirable to incorporate a facile, inexpensive and specific termite-detecting sensor within the modern monitoring/baiting programs.

For example, PCT Publication No.WO 93/23998 (December 9, 1993) discloses a simple efficient sensor that utilizes a thin strip of conductive soft metal (i.e. aluminum foil) placed over wooden blocks or stakes. In another publication by Su, WO 98/18319, a silver particle circuit placed over a wooden stake using a conductive pen is used as a sensor. The wooden stake is typically used as a monitoring device for the Sentricon system. The sensor is useful in detecting termites because the circuit is readily broken by termite feeding when it is placed in areas with termite activity. Thus, it is successful in the detection of true positive responses. Japanese Pat. No. 9-98701 (Ikari Shodoku K.K.,

April 15, 1997) also describes a similar termite-detecting device comprising of an electrically conductive circuit secured on a medium damageable by termite feeding, such as paper. More recently, PCT Application No. PCT/US99/16519 (WO 01/06851 A1), PCT Application No. PCT/US00/26373 (WO 02/26033 A1) and PCT Application No. PCT/US02/24186 (WO 03/013237 A2) also teach electronic sensing devices and systems for monitoring termite activity.

Other monitoring/baiting programs include Japanese Pat. No. 63-151033 (System Maintenance, Inc., 1991), which describes a system in which a wooden housing containing another wooden detector is first placed in the soil to attract termites, and the detector is replaced with an insecticide material when termites are found in the wooden housing. In addition, U.S. Pat. 5,950,356 (Nimocks et al., 1999) describes an apparatus comprised of a housing with an opening that contains nontoxic baits to detect termites. Toxic baits are then placed into the housing (without removing the nontoxic baits) when termites are detected in the housing.

Further, U.S. Patent 5,937,571 (FMC Corp., 1999) discloses a tamper resistant bait station containing cellulose baits. The station has a plurality of apertures to allow termite access to a cellulose bait impregnated with a slow-acting toxicant. Because the cellulose baits are placed in soil and exposed to outdoor elements (rainfall, temperature fluctuation, high humidity, and biotic factors such as fungal decay and damage by other insects) through the housing apertures, the baits degrade rapidly and necessitate frequent onsite inspection and replacement of these cellulose baits. These systems are intended for both remedial and preventative control and rely on a routine monitoring program to apply baits or to detect termites so that toxic baits can be applied. However, the manual onsite inspection currently employed by those who are using these systems is also the most

labor-intensive and costly element of the systems. Moreover, the onsite monitoring procedure becomes virtually impractical when the system has to be used in a large area such as an agricultural farm. For example, subterranean termites are known to damage sugarcane, and thousands of stations are needed for effective control of termite populations in a sugarcane plantation. Stations placed in the sugarcane plantation tend to get lost in the vastness of the land, and inspection of such a large number of stations is not cost-effective.

Another category of termite baiting methods is intended for remedial control, i.e., to be used when termites are found. An above-ground station made of a re-closable plastic bag containing bait matrix as described by Su et al (1997, *J. Econ. Entomol.* **90**: 809-817) has an opening for termite access to the baits and is placed directly over active infestations of subterranean termites in a house or tree to allow an immediate bait consumption by termites. U.S. Pat. 5,778,596 (Henderson et al., 1998) describes an elaborate double-chamber baiting system that is placed in the vicinity of termite populations so that termites can be placed in or connected to the first chamber containing non-toxic food and thus preconditioned before entering the second chamber that contains toxic food. U.S. Pat. 6,058,646 (Bishoff et al., 2000) employs an interchangeable station containing termite baits that are to be used in an above-ground system. The housing has a plurality of apertures that allows termites immediate access to baits, and multiple stations can be stacked on top of each other to provide termites with continuous access to bait material. Because baits are provided for immediate consumption by termites for these above-ground systems, a periodical inspection is needed to determine whether bait replacement is necessary; this requires onsite visits by technicians to inspect these systems. Moreover, as with the in-ground system used in the monitoring-baiting

program, baits for remedial control are applied only when termites are present.

Another problem with present combined monitoring-baiting systems is "station avoidance" by some termite species such as *Reticulitermes virginicus* in North America, or *R. speratus* in Asia. These species are known to be sensitive to disturbance and have a tendency to stay away from feeding sites that are disturbed. For these species, the monitoring-baiting procedure can be difficult because once the stations are opened and baits are placed, these termites often do not return to the stations to consume baits.

SUMMARY OF THE INVENTION

This invention provides bait that is hermetically sealed with a non-biodegradable material, and further includes an electrically conductive material, preferably an electrically conductive non-metallic material, such as an electrically conductive material containing carbon, each of which can be tunneled or chewed through by termites. Because the bait is hermetically sealed in a weather-resistant enclosure, it remains intact in the environment for an extended period (i.e. years) until termite feeding occurs. For convenience, this novel bait including the electrically conductive material is referred to as the monitoring/hermetically sealed (HS) bait. The monitoring/HS bait of the present invention can be used with or without monitoring; i.e. it can be used as a single-step application without the need for monitoring as currently performed by pest control professionals, or it can be used with monitoring to readily determine the presence or absence of termites. The monitoring/HS bait of the instant invention can also be distributed in a large quantity throughout, for example, an agricultural field.

Specifically, the present invention provides a hermetically sealed bait package composed of a consumable material that is resistant to environmental degradation. The

need for a separate monitoring step wherein monitoring is done without employing a termiticide, followed by a baiting step, is eliminated by this delivery system that releases termite toxicant only upon termite feeding. The monitoring/HS bait can be used separately or as replacements in already existing termite bait stations, such as, for example, the Sentricon® Termite Colony Elimination bait station. In another embodiment of the present invention, the subject invention is enclosed in a durable, sturdy station housing with termite-access holes to protect, from physical breakage, any soft and/or flexible material present in the monitoring/HS bait.

The present invention further provides a non-invasive means of determining whether termite feeding has occurred by receiving input from the electrical bridging circuit, thus eliminating the need to open the termite station. This increases operator efficiency and minimizes disturbance of the termites within the station thereby reducing the risk of abandonment of the station.

The present invention also provides for a termite bait station in which monitoring, baiting and recruiting of termites occurs within the same delivery system. This reduces manual labor and improves the efficiency in the termite colony elimination process.

Accordingly, the monitoring/HS bait comprises a sealed hollow receptacle made from weather-resistant material that is palatable to termites and a bait matrix substantially encapsulated by the receptacle, and includes an electrically conductive circuit material that is affixed to or embedded in the receptacle or bait material. The bait matrix contains at least one termite toxicant. The electrically conductive circuit material is breakable by termite feeding and tunneling and forms a continuous electrical bridging circuit such that when termite feeding breaks the electrically conductive circuit material, the continuous electrical bridging circuit is broken. As used herein, reference to an electrical bridging

circuit or electrically conductive circuit, besides circuits that can be monitored for breakage to determine the presence or absence of termites, also includes circuits that can be monitored to determine the extent of bait consumption. The continuous electrical bridging circuit is also resistant to breakage or deterioration for an extended period of time from exposure to meteorological elements such as changes in ambient humidity and/or temperature fluctuation. An electronic device can monitor the integrity of the electrical circuit and communicate the status of termite feeding, such as described in PCT Application No. PCT/US99/16519 (WO 01/06851 A1), PCT Application No. PCT/US00/26373 (WO 02/26033 A1), or PCT Application No. PCT/US02/24186 (WO 03/013237 A2), all of which are incorporated herein by reference.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG **1** shows various embodiments of the receptacles; **A:** A cylindrical cellulose-based bait hermetically wrapped and sealed from all sides with a closed-cell polyethylene sheet; **B:** A receptacle with compressed cross section; **C:** A receptacle with plastic or wire wrapping; **D:** A receptacle with groove texture; **E:** A bait such as shown in **FIG 1A** enclosed in a durable and sturdy station with termite-access openings.

Fig. **2** shows an HS bait that can be installed vertically in the soil (**A**), in a shallow trench near the soil surface (**B**), or directly on the soil surface (**C**).

Fig. **3** shows a cellulose bait matrix inside an HS bait that remained dry and intact 1 year after placement in soil under field conditions.

Fig. **4** shows a HS bait fed on by termites (**A**); and, a HS bait not fed on by termites (**B**).

Fig. **5** shows termite activity as measured by the number of active monitoring

stations before, during, and after application of a HS bait.

Fig. **6** shows an embodiment of the monitoring/HS bait.

DETAILED DESCRIPTION OF THE INVENTION

According to Fig. **1** and Fig. **2**, the HS bait **1** comprises a hollow receptacle **2**, preferably in the shape of a cylinder (Fig. **1A**), which houses a bait matrix **3**. The receptacle **2** has a wall **4** (shown in Fig. **1A**) made of material that is weather-resistant and has affixed to or embedded therein an electrically conductive material such that an electrical bridging circuit is present, thereby protecting the bait matrix from environmental conditions, such as, for example, rainfall, high humidity, and temperature fluctuation, and biotic factors such as fungal decay. The receptacle **2** is sealed at all ends **5**. Preferably, when the receptacle is in the shape of a cylinder, it is sealed at least one end **5** and more preferably both ends **5** with an end-cap (or end-caps) **7**. The end-caps **7** are preferably made of the same weather-resistant material that makes up the cylinder **1**. The HS bait can be placed in the soil (Fig. **2A**) at any depth to simulate a piece of wood for subterranean termites.

Another embodiment is an HS bait **1** with a compressed shape (Fig. **1B**) that can be placed near the soil surface in a shallow trench (Fig. **2B**) or directly on the soil surface (Fig. **2C**). The compressed shape makes it easier to bury in a shallow trench, and prevents the HS bait **1** from rolling when placed on the soil surface. This configuration simulates fallen wooden branches, logs or other cellulose materials such as sugarcane cuttings near or on the soil surface that are foraged by subterranean termites, such as, for example, the *Coptotermes* or *Reticulitermes* species. For some *Heterotermes* species, HS baits are alternatively placed above the ground (Fig. **2C**) because these species tend to

search for cellulose materials on the soil surface.

In yet another embodiment, plastic or wire **6** may be wrapped over the HS bait **1** so that the indentations caused by the wrappings provide desirable texture for termites to initiate tunneling (Fig. **1C**). Still another embodiment is to create groove texture **8** on the surface of the HS bait **1** to encourage termite feeding (Fig. **1D**). A further embodiment encloses the bait matrix **3** in a durable and sturdy receptacle **2** with termite-access openings **10** (Fig. **1E**).

The bait matrix **3** comprises a food source for termites, generally a cellulose containing material such as wood, paper or similar materials, that is impregnated with at least one termite toxin, and preferably at least one slow-acting and non-repellent toxicant as defined by Su et al., *J. Econ. Entomol.* **75**: 188-193 (1982), incorporated herein by reference, to control the population of termites in an area. Examples of such toxicants are hexaflumuron, noviflumuron, sulfluramid, diflubenzuron, dihaloalkyl arylsulfone, and other toxicants such as those described in WO 93/23998; U.S. Patent No. 5,556,883; U.S. Patent No. 5,811,461; U.S. Patent No. 5,886,221; and U.S. Patent No. 5,945,453, all of which are incorporated herein by reference. In addition, for some embodiments of the subject invention, the electrically conductive material may be affixed to or embedded in the bait material.

The receptacle wall **4** is made of weather-resistant material that is durable and provides protection of the bait against environmental factors such as rainfall, high humidity, temperature fluctuation, and other biotic factors such as fungal decay. Further, such material is not readily broken by the activity of other soil dwelling organisms such as earthworms, ants, beetle larvae, or activity of other wood destroying insects such as carpenter ants, powderpost beetles, bark beetles, wood boarders, etc. Examples of

weather-resistant materials are closed-cell polyethylene, expanded polystyrene, expanded polypropylene, textured polyethylene (ArtForm®), vinyl, polyol resin of polmeric diisocyanate (Insta-Foam®), absorbent paper with polyethylene backing, cellular rubber, sponge rubber, etc. In fact, many types of polymer-based padding sheets, foam blocks, with or without cellulose, that are used as packaging materials, insulation, or laboratory bench top protection sheets can be used for this purpose. These materials possess the desired characteristics in that they are resistant to environmental factors and yet their soft and foam texture are uniquely preferred by termites for tunneling and excavation. Field experiments consistently show that other soil dwelling organisms or wood destroying insects do not tunnel or excavate these materials. Preferably, the choice of the wall material is also based on the ability of the wall material to have an electrically conductive material affixed to or embedded in the wall material in a manner such that an electrical bridging circuit is created; for example, by affixing an electrically conductive ink or similar conductive material to the wall material. It is particularly preferred to use as a conducting material a non-metallic electrical conducting material, such as an electrically conductive carbon ink.

In an alternative preferred embodiment, the cylinder also has a recruitment chamber **9** useful in recruiting termites to the bait (Fig. **6**). Specifically, a recruitment chamber **9** is at one end **5** while a second chamber **11** is at the other end **5.** The recruitment chamber **9** is readily created, for example, by using a bait matrix **3** that is shorter than the height of the cylinder, or other receptacle, containing the bait matrix **3**. The cap **13** is placed over, or otherwise associated with the portion of the cylinder containing the recruitment chamber **9** such that termites located at or near a particular location can be placed in the recruitment chamber **9** and as described below must feed or

tunnel their way through the toxin containing bait matrix **3** and cylinder wall **4** if the termites are to successfully leave the device. Preferable, the recruitment chamber **9** is covered externally with a thin cap **13** made of plastic, which can easily be removed by a field technician but cannot be readily eaten through by termites. The thin cap **13** forces the termites to exit the cylinder by feeding through the bait matrix **3** and then through the wall **4** of the cylinder.

An electrically conductive circuit **15** is affixed to or embedded in the wall **4** of the cylinder (Fig. **6**). The electrically conductive circuit **15** provides a means of determining if termite-feeding activity has penetrated the wall **4**. If the circuit **15** is continuous, termite feeding has not occurred; if the circuit **15** has been broken, the likely cause is termite feeding. The circuit **15** is resistant to breakage for an extended period of time from exposure to meteorological elements such as changes in ambient humidity and/or temperature fluctuation.

More preferably, the electrically conductive and continuous circuit **15** is composed of a series of uniform, closely spaced, parallel loops **17**. The loops **17** extend from one end **5** to the other end **5** and completely encircle the cylinder. The spacing between each loop **17** is from between 1/16 inch to 1/2 inch, and preferably about 1/4 inch. The circuit **15** has a width of from between 1/16 inch to 1/4 inch, and preferably about 1/8 inch.

The electrically conductive circuit **15** is preferably made from such materials as silver particle traces, aluminum foil, conductive polymers such as conductive epoxy glue, or any particles of conductive materials bonded together with glue, including polymers, gold, copper, nickel or iron (see, for example, WO 98/18319 which is incorporated herein). The circuit **15** is more preferably comprised of an electrically conductive non-

metallic material such as an electrically conductive carbon containing material which has a higher internal resistance than circuits formed by metals. Various carbon containing materials or carbon inks that are suitable for this use are such as those described in U.S. Pat. 6,100,805 or PCT Application No. PCT/US00/26373 (WO 02/26033 A1). Carbon ink circuits can be used advantageously because they are not easily bridged by ionic water. In an even more preferred embodiment, the carbon ink circuit is printed on or embedded in the inside of the cylinder, preferably on the inside of the cylinder wall, to protect the circuit **15** from abrasion.

In a preferred embodiment, an electronic communications system is used to determine the status of the circuit **15** and to determine whether termite feeding has occurred. Frequently, at least some of the circuitry required for monitoring the status of the electrical bridging circuit is associated with the durable station housing or a cover for the durable station housing. Alternatively, such circuitry can be associated with a cover or other attachment means in contact with the bait receptacle. For monitoring uses, the electronic bridging circuit typically has leads, couplers or similar connection means whereby the bridging circuit can be coupled to other circuitry so that the electronic bridging circuit can be monitored for status information concerning the presence or absence of termites. The electronic communications system can contain two sub-systems. One sub-system can query the electric circuit **15** to determine if feeding has occurred. Another sub-system can communicate the status of the circuit **15**. In a more preferred embodiment, the electronic communications system employs radio frequency (RF) transmitters and receivers. Examples of remote detection systems that may be used with the present invention include those disclosed in PCT Application No. PCT/US99/16519 (WO 01/06851 A1), PCT Application No. PCT/US00/26373 (WO 02/26033 A1) and

PCT Application No. PCT/US02/24186 (WO 03/013237 A2).

In yet another embodiment of the invention, the compositions of the receptacle **2** and the bait matrix **3** can be altered, thus allowing for the control of many other insects that have similar feeding behavior.

The HS bait of the present invention can also be applied to in-ground and above ground control systems, such as, for example, the bait station used in the Sentricon® Termite Colony Elimination system.

The disclosures in this application of all articles and references, including patents and publications, are incorporated herein by reference.

The invention is illustrated further by the following examples, which are not to be construed as limiting the invention in scope or spirit to the specific embodiments described in them.

Example 1

Durability test. Twenty HS baits containing toxin-containing cellulose baits similar to Fig. **1A** are placed in the soil for 12 months to test their durability. The test is conducted in soil under outdoor conditions in south Florida. There is no known termite activity in the soil for the test site. Ten wooden stakes are planted in the soil as a comparison. After 12 months of exposure, HS baits are cut open to examine the status of termite baits. In all cases, the cellulose baits remain dry and intact (Fig. **3**), while wooden stakes are badly decayed by fungi and in some cases damaged by wood destroying beetles. Soil dwelling organisms such as earthworms are also found in wet and badly decayed stakes. The results demonstrate that the closed-cell polyethylene wrapping provided protection of cellulose baits against environmental factors such as rainfall, high humidity, temperature fluctuation, and other biotic factors such as fungal decay, soil

dwelling organisms or wood destroying beetles.

Example 2

Field efficacy test 1.

Wooden stakes (1" x 1.5" x 12") are placed in the soil in the backyard of a residential home to detect termite activity. After survey stakes are infested by termites, underground monitoring stations similar to that described by Su & Scheffrahn, *Sociobiology* **12**: 299-304 (1986) are installed. Termite activity is found in two monitoring stations. Subsequently, more stations are installed over a period of time, but in all cases termites do not return to the stations once they are opened for inspection. Similar observations are made in the infested wood in the house and in other wooden stakes in soil (i.e. termites do not return to the locations when they are disturbed). The results agree with previous experiences with some infestations of *R. virginicus*.

Eight HS baits in the configuration of Fig. **1C** are placed vertically in the soil (Fig. **2A**) surrounding the house, and are not disturbed for ten months. The cellulose bait matrix is similar to that used in the Sentricon® system and contains 0.5% hexaflumuron. Termite activity is observed in the house and mulch piles next to the house two months after initial placement of the HS baits, but by the fourth month, no termite activity has been detected in any of the survey stakes, the monitoring stations, the house or the landscape surrounding the house. After termite activity has been absent from the site for over seven months, the eight HS baits are removed from the soil for inspection, and evidence of termite feeding is observed in two HS baits (Fig. **4A**). Over 80% of the cellulose bait material in the HS baits where consumption was noted had been consumed, but no live termite is detected therein. The cellulose bait in the remaining six HS baits with no detectable termite activity remains dry and intact (Fig. **4B**).

Field efficacy test 2.

Subterranean termite infestations and spring swarms are observed in a single family home. Despite repeated soil treatments, termite activity persists. A stake survey similar to the one employed in field efficacy test 1 above reveals high activity of the eastern subterranean termite, *R. flavipes*. Subsequently, two monitoring stations harbor termite activity, and after another two months, the number of active stations increases to five (Fig. **5**). The *R. flavipes* population maintains this level of activity for an additional five months, during which time another termite swarming is observed. At this time, 25 HS baits containing 0.5% hexaflumuron similar to Fig. **1C** are installed in the soil surrounding this house. After about 45 days, termites collected from the five monitoring stations contain abnormally high proportions of secondary reproductives; an indication of population disruption by hexaflumuron. Also, the termites collected died shortly thereafter when kept under laboratory conditions; another indication that the population had consumed and are affected by hexaflumuron. Following another 45 days, termites are collected from one station, with the other four stations not showing any sign of termite activity, i.e. no termite activity or termite feeding. Of the 79 termites collected, 46 are secondary reproductives; and the 33 workers exhibit signs of hexaflumuron effects such as sluggish movements and marble coloration. No termite activity is found in any of the monitoring stations five months after the installation of the 25 HS baits (Fig. **5**). Of these 25 HS baits, two are consumed by termites (Fig. **4A**), and 23 are untouched (Fig. **4B**). As with Example 1, the cellulose bait in the 23 untouched HS baits remain dry and intact. Because termite consumption of the baits occurred sometime between this five month period after installation of the HS baits, and no termite activity has been detected since that time, it is concluded that the *R. flavipes* population that had been infesting the house

in question is eliminated.

The invention and the manner and process of making and using it, are now described in such full, clear, concise and exact terms as to enable any person skilled in the art to which it pertains, to make and use the same. It is to be understood that the foregoing describes preferred embodiments of the present invention and that modifications may be made therein without departing from the spirit or scope of the present invention as set forth in the claims. To particularly point out and distinctly claim the subject matter regarded as the invention, the following claims conclude this specification.

WHAT IS CLAIMED IS:

1. A hermetically sealed bait for use in monitoring or eradicating termites that is substantially resistant to environmental degradation comprising

a receptacle made of water-resistant, termite-edible material;

a bait matrix substantially encapsulated by the receptacle, the bait matrix further comprising at least one termite toxin; and

an electrically conductive circuit material affixed to or embedded in the receptacle or bait matrix; the electrically conductive circuit material forming an electrical bridging circuit such that termite consumption of the electrically conductive circuit material causes a detectable change in the electrical bridging circuit.

2. The hermetically sealed bait of claim 1 wherein the electrically conductive circuit material comprises a continuous electrical bridging circuit that can be broken by termite feeding.

3. The hermetically sealed bait of Claim 2 wherein the receptacle has a recruitment chamber in one portion of the receptacle, the bait matrix substantially encapsulated by the remaining portion of the receptacle.

4. The hermetically sealed bait of Claim 3 wherein the recruitment chamber is covered externally by a cap made of material not readily edible by termites, the recruitment chamber and cap causing termites present in the recruitment chamber to exit the recruitment chamber by tunneling or feeding through the bait matrix and a receptacle wall.

5. The hermetically sealed bait of Claim 2 wherein the electrically conductive circuit material is an electrically conductive non-metallic material containing carbon.

6. The hermetically sealed bait of Claim 5 wherein the electrically conductive non-metallic material is a carbon ink that is printed on or embedded in the inside of a receptacle wall.

7. The hermetically sealed bait of Claim 1 wherein the receptacle is shaped in the form of a cylinder having two ends.

8. The hermetically sealed bait of Claim 7 wherein the cylinder is sealed at each end by a cap made of a water-resistant, termite-edible material.

9. The hermetically sealed bait of Claim 1 further comprising an electronic communications system to monitor the status of the circuit and determine if termite feeding has occurred.

10. The hermetically sealed bait of Claim 1 wherein the bait is placed in a shallow trench or on a soil surface.

11. The hermetically sealed bait of Claim 10 wherein the receptacle is compressed such that the station remains substantially immobile in the shallow trench or on the soil surface.

12. The hermetically sealed bait of Claim 2 wherein the receptacle further comprises one or more indentations on an outer surface of the receptacle, the one or more indentations providing a texture favorable to termites for tunneling initiation.

13. The hermetically sealed bait of claim 1 further comprising a durable station housing containing termite-access openings to hold at least a portion of the hermetically sealed bait.

14. The hermetically sealed bait of claim 13 wherein circuitry responsible for monitoring the status of the electrical bridging circuit is associated with the durable station housing or a cover for such station housing.

15. The hermetically sealed bait of claim 2 wherein the termite toxin comprises hexaflumuron or noviflumuron.

16. The hermetically sealed bait of claim 13 wherein the termite toxin comprises hexaflumuron or noviflumuron.

17. A method for monitoring or eradicating termites at a site, the method comprising:

placing at least one hermetically sealed bait substantially resistant to environmental degradation at the site; the bait comprising a receptacle made of water-resistant, termite-edible material; a bait matrix substantially encapsulated by the receptacle, the bait matrix further comprising at least one termite toxin; and, an electrically

conductive circuit material affixed to or embedded in the receptacle or bait matrix, the electrically conductive circuit material forming an electrical bridging circuit such that termite consumption of the electrically conductive circuit materialcauses a detectable change in the electrical bridging circuit

18. The method of claim 17 wherein the electrically conductive circuit material comprises a continuous electrical bridging circuit that can be broken by termite feeding.

19. The method of claim 17 further comprising a durable station housing containing termite-access openings to hold at least a portion of the hermetically sealed bait.

20. The method of Claim 18 further comprising:

connecting the circuit to an electronic communications system for detecting breakage of the circuit due to termite feeding.

21. The method of Claim 18 wherein the receptacle has a recruitment chamber in one portion of the receptacle, and the bait matrix is substantially encapsulated by the remaining portion of the receptacle.

22. The method of Claim 20 wherein the the recruitment chamber is covered externally by a cap made of material not readily edible by termites, the recruitment chamber and cap causing termites present in the recruitment chamber to exit the

recruitment chamber by tunneling or feeding through the bait matrix and a receptacle wall.

23. The method of Claim 23 wherein the electronic communications system detects the breakage of an electrically conductive circuit containing an electrically conductive non-metallic material.

24. The method of Claim 23 wherein the non-metallic material is carbon.

25. The method of claim 18 wherein the termite toxin comprises hexaflumuron or noviflumuron.

26. The method of claim 19 wherein the termited toxin comprises hexaflumuron or noviflumuron.

FIG. 1A

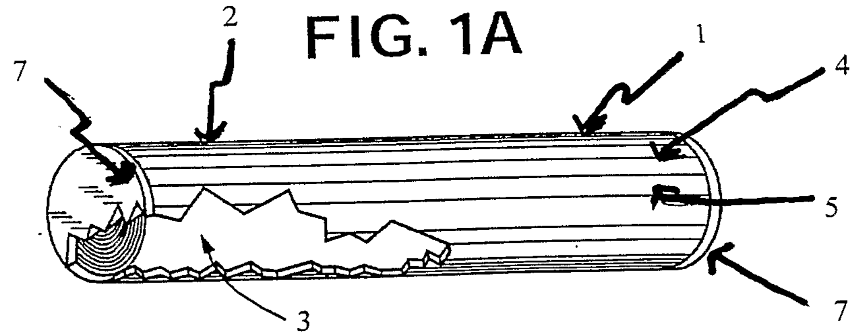


FIG. 1B

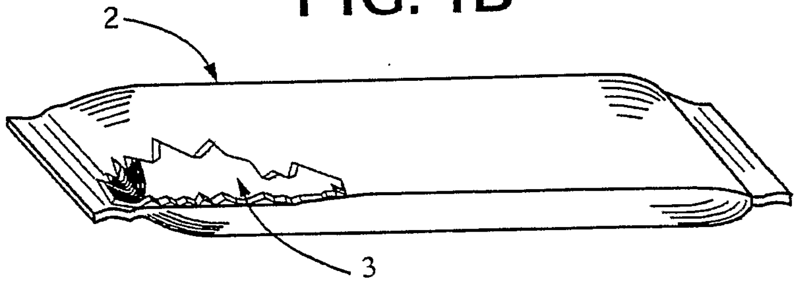


FIG. 1C

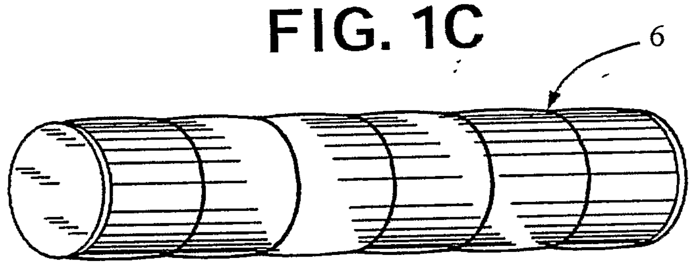


FIG. 1D

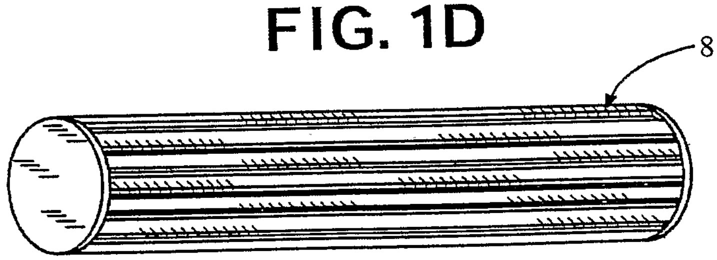
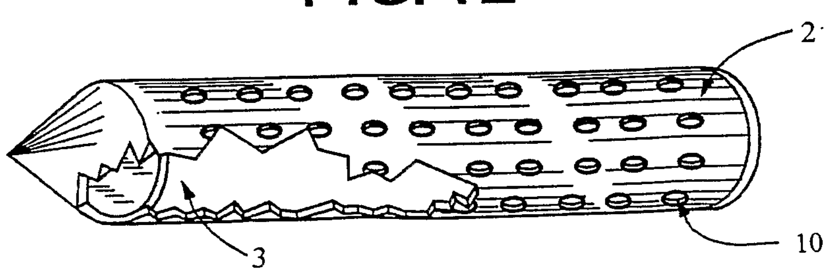


FIG. 1E



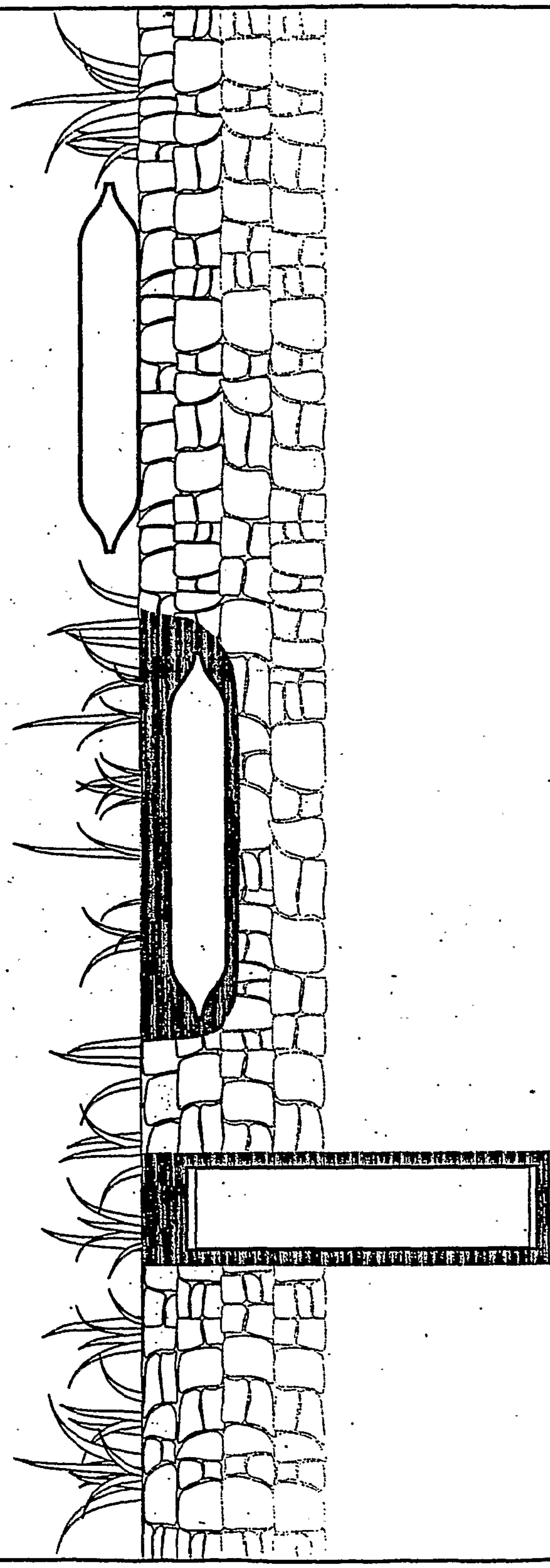


Fig. 2A

Fig. 2B

Fig. 2C

Fig. 2

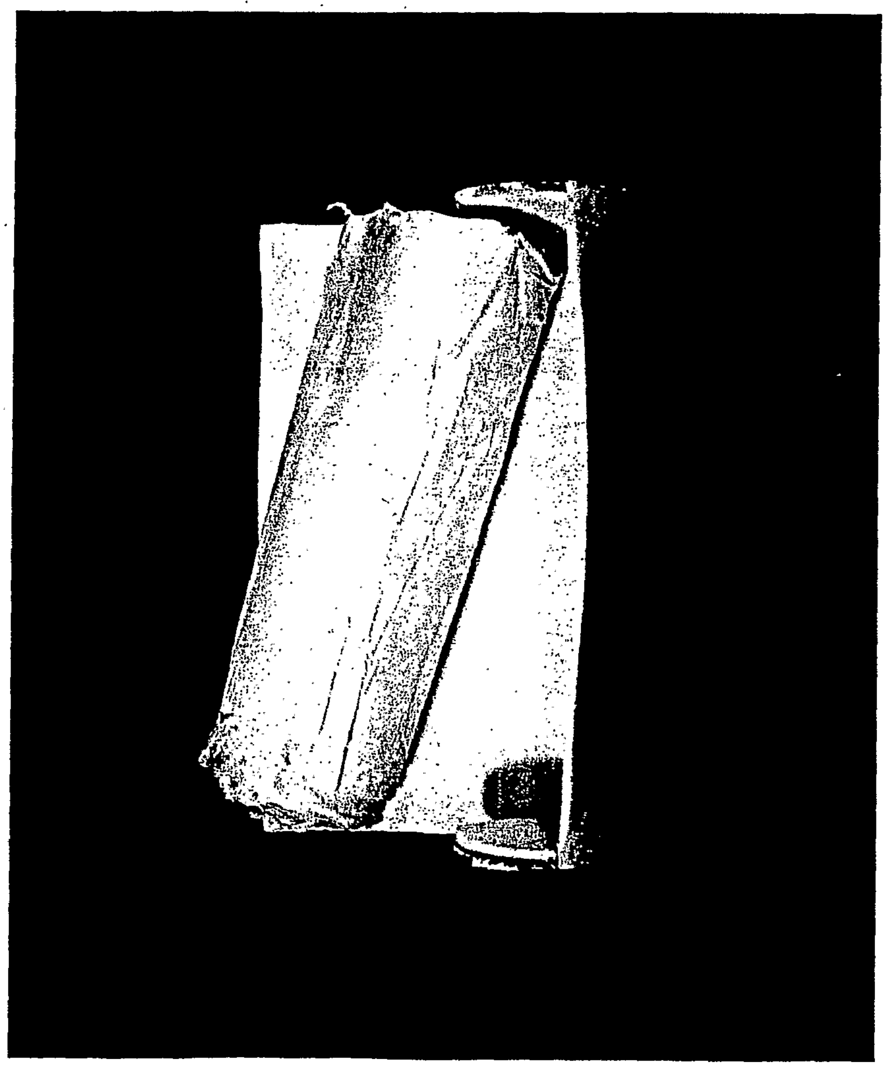


Fig. 3

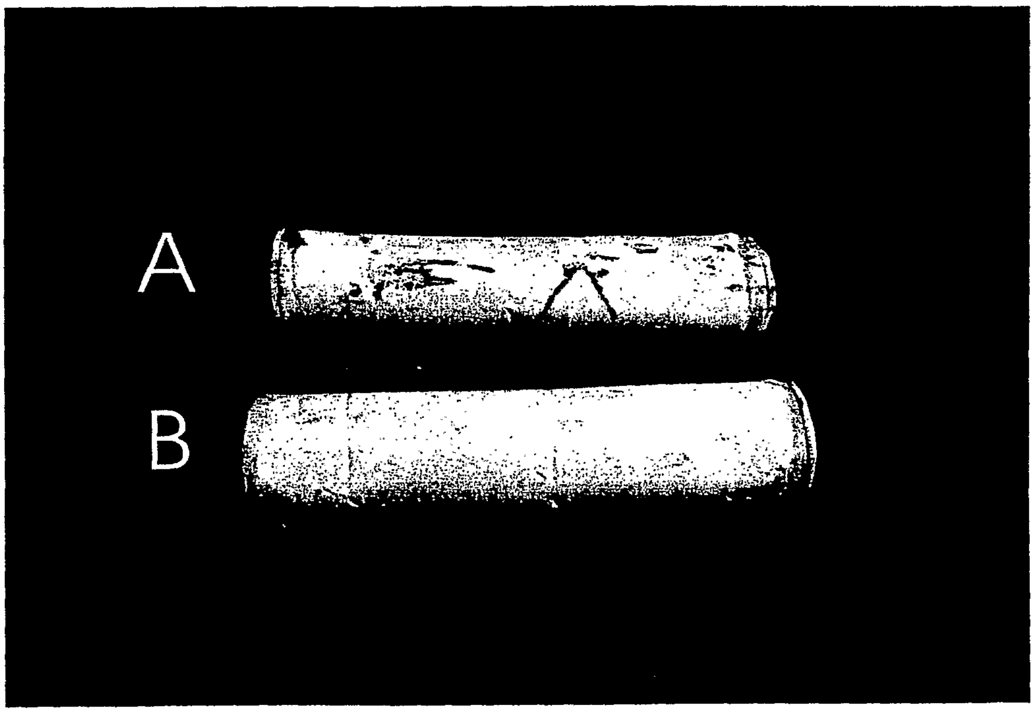
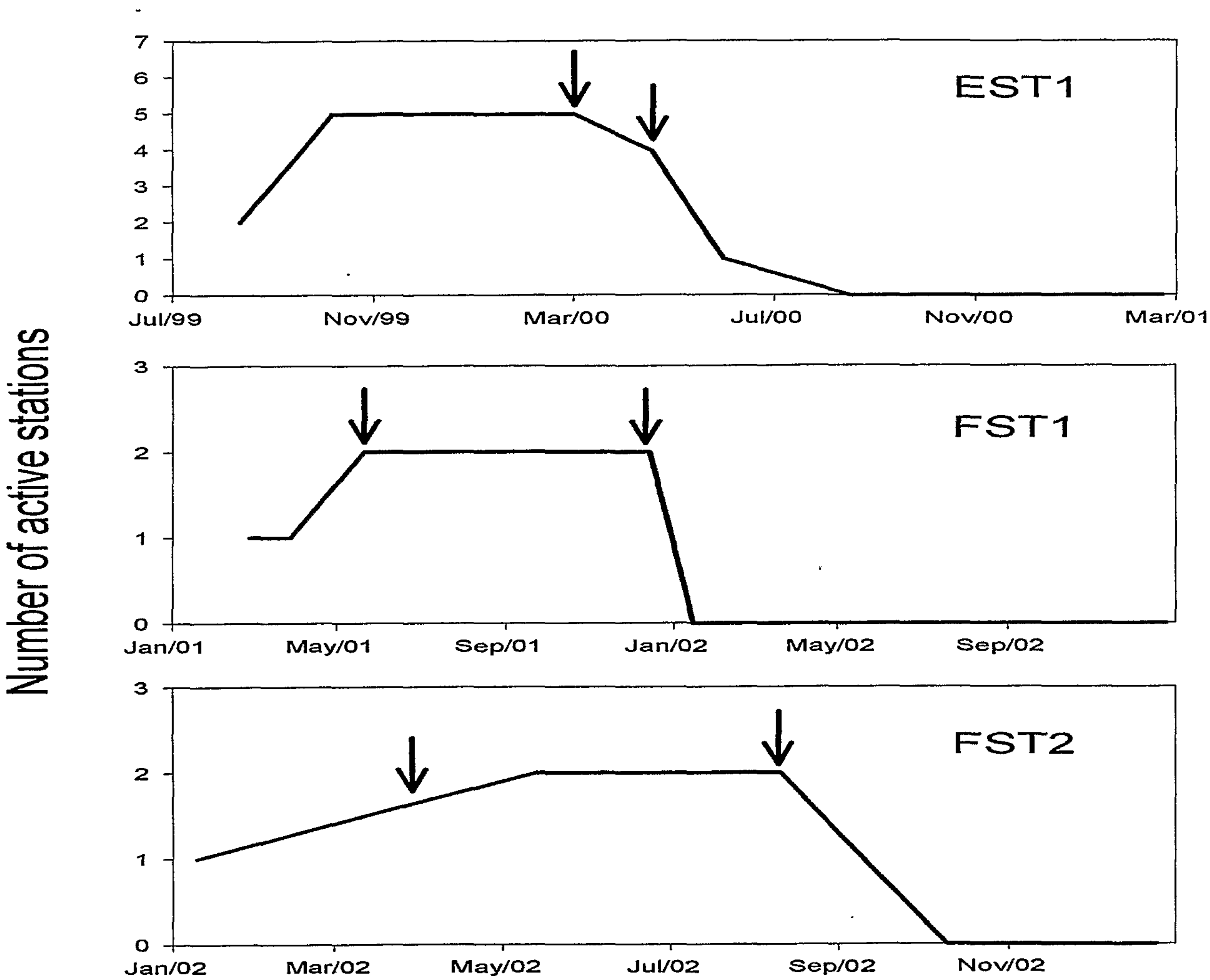


Fig. 4


Number of active stations
EST1
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Nov/99
Mar/00
Jul/00
Nov/00
Mar/01
FST1
Jan/01
May/01
Sep/01
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FST2
Jan/02
Mar/02
May/02
Jul/02
Sep/02
Nov/02

Fig. 5

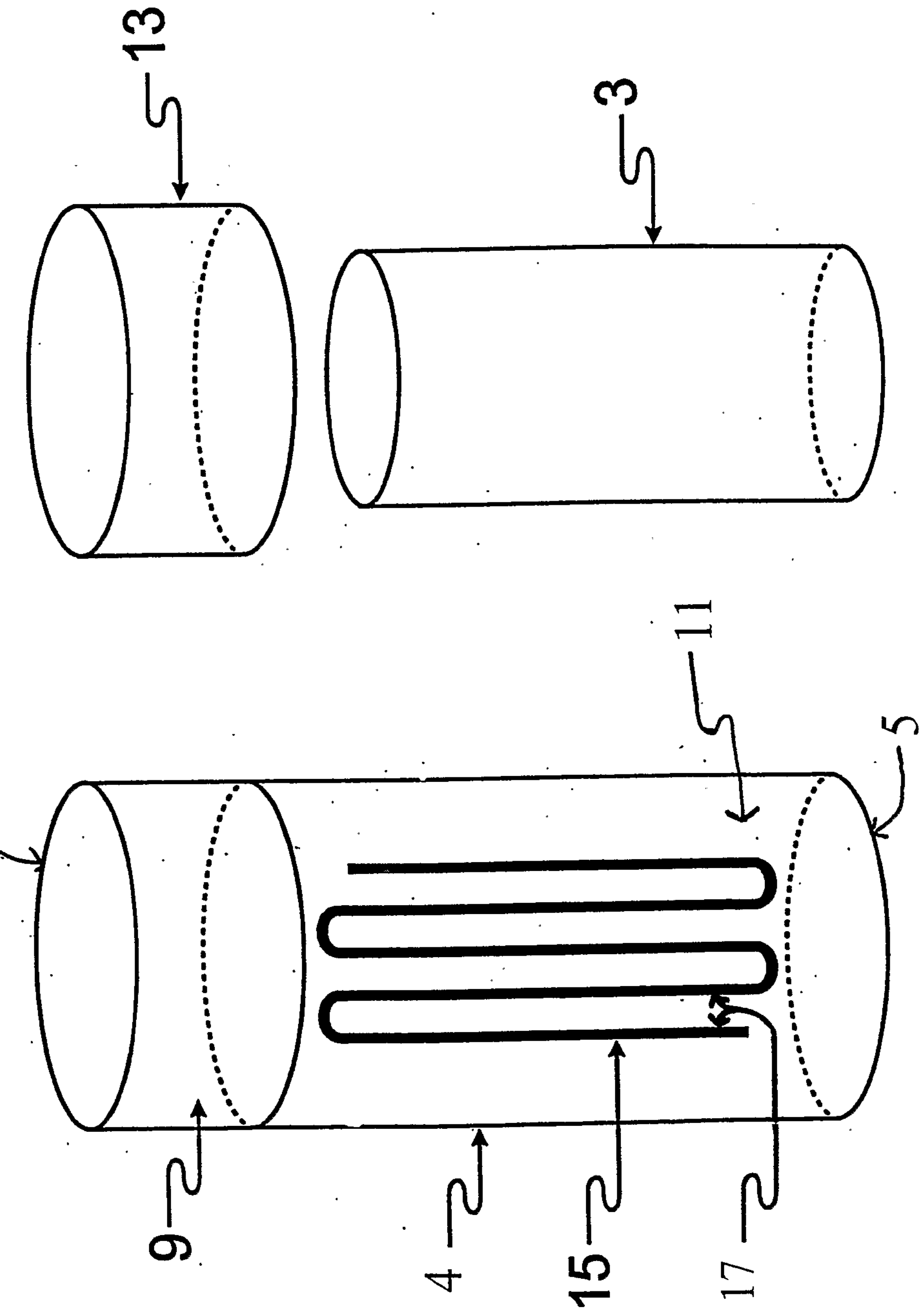

Fig. 6

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 03/08062

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 A01M31/00 A01M1/20 A01M1/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 A01M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y A	US 2001/054962 A1 (BLACK DON ET AL) 27 December 2001 (2001-12-27) page 1 -page 13; figures 1-4,6,7,10,23	1-5,7-26 6
Y	EP 1 142 475 A (UNIV FLORIDA ;DOW AGROSCIENCES LLC (US)) 10 October 2001 (2001-10-10) column 5 -column 25; figures 1-3	1-5,7-26
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A	US 5 592 774 A (GALYON STANLEY D) 14 January 1997 (1997-01-14) column 4 -column 8; figures 1,2	1,17

-/--

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

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"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

27 May 2003

Date of mailing of the international search report

04/06/2003

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Authorized officer

Moeremans, B

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/US 03/08062

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PUBN-DATE:	October 9, 2003

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A01M001/02

EUR-CL (EPC): A01M001/02 , A01M001/20

ABSTRACT:

CHG DATE=20031203 STATUS=O>Disclosed is a hermetically sealed (4) termite bait (3) station having an electrical bridging circuit (15) useful in the elimination of termite colonies and a method of substantially eradicating termites in an area comprising placing in the area at least one such hermetically sealed station.